
Space Weather Technical Forecast

Issued on Sunday, 13 August 2023 at 13:31 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Peak Chance of G1/Minor Geomagnetic Storm intervals Day 2-3 (14-15 Aug). Chance of Minor Radio Blackouts/R1 throughout. Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity, as measured at GOES16 has been Low throughout the past 24 hours, with the peak flare observed a C5.3 at 12/2352UTC from AR3395 in the northwest. There are currently seven sunspots on the visible disc, including three unnumbered regions. The most complex region on the disc is AR3395 (Dai/Beta-Gamma-Delta), though many of its leading spots continue to fade and the delta spot to the rear is now marginal. AR3397 (Dsi/Beta) has continued to develop in its trailing portion. The other numbered regions remain relatively unchanged.

The unnumbered bi-polar region in the southwest has shown slight development. Two other small unnumbered regions have recently emerged in the northeast of the disc, including one Cro/Beta region that developed quickly through the UTC morning of Day 1 (13 Aug). While there were some Coronal Mass Ejections (CMEs) visible on coronagraphs in the period, these mainly appear to be linked with the far-side western hemisphere. No Earth-directed CMEs are currently expected.

Solar Wind / Geomagnetic Activity: Solar winds, as observed at ACE at L1, have been largely at Slightly Elevated levels, initially around 420-440 km/s. Winds gradually declined through the period, fluctuating between Slightly Elevated and Slow-Ambient levels. The phi angle has been predominantly negative (Towards the Sun). The solar wind density remained below average in single figures ppcc. The IMF remained weak and steady at around 5nT. The north-south component fluctuated weakly +4 to -5nT. Since 13/0450 UTC the IMF has largely remained oriented northward, weakly aligned with Earth's magnetic field. The net result of the observed solar wind characteristics was Quiet (Kp 0-2) geomagnetic activity throughout the past 24 hours.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux has remained at background levels.

High energy (greater than 2MeV) electron flux at GOES16 is exhibiting an attenuated diurnal oscillation, remaining largely at Normal Background levels but briefly peaking at High (1003pfu) at 12/1530UTC. The associated 24-hour integrated fluence remained below the Active level (1e8 integrated pfu), with 4.16e7 integrated pfu observed at 13/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a daily Chance of isolated M-class flares, most likely from AR3395 or AR3397, both in the northwest. Flare risk later in the period may see contributions from a developing, unnumbered, region in the northeast. Otherwise, activity is likely to remain Low.

Solar Wind / Geomagnetic Activity: There are currently no Earth-directed CMEs. The next fast wind enhancement is expected to be from the arrival of the HSS of CH33/+, either late Day 2 (14 Aug) or early Day 3 (15 Aug), with speeds potentially reaching 500km/s. Mainly Quiet (Kp 0-2)

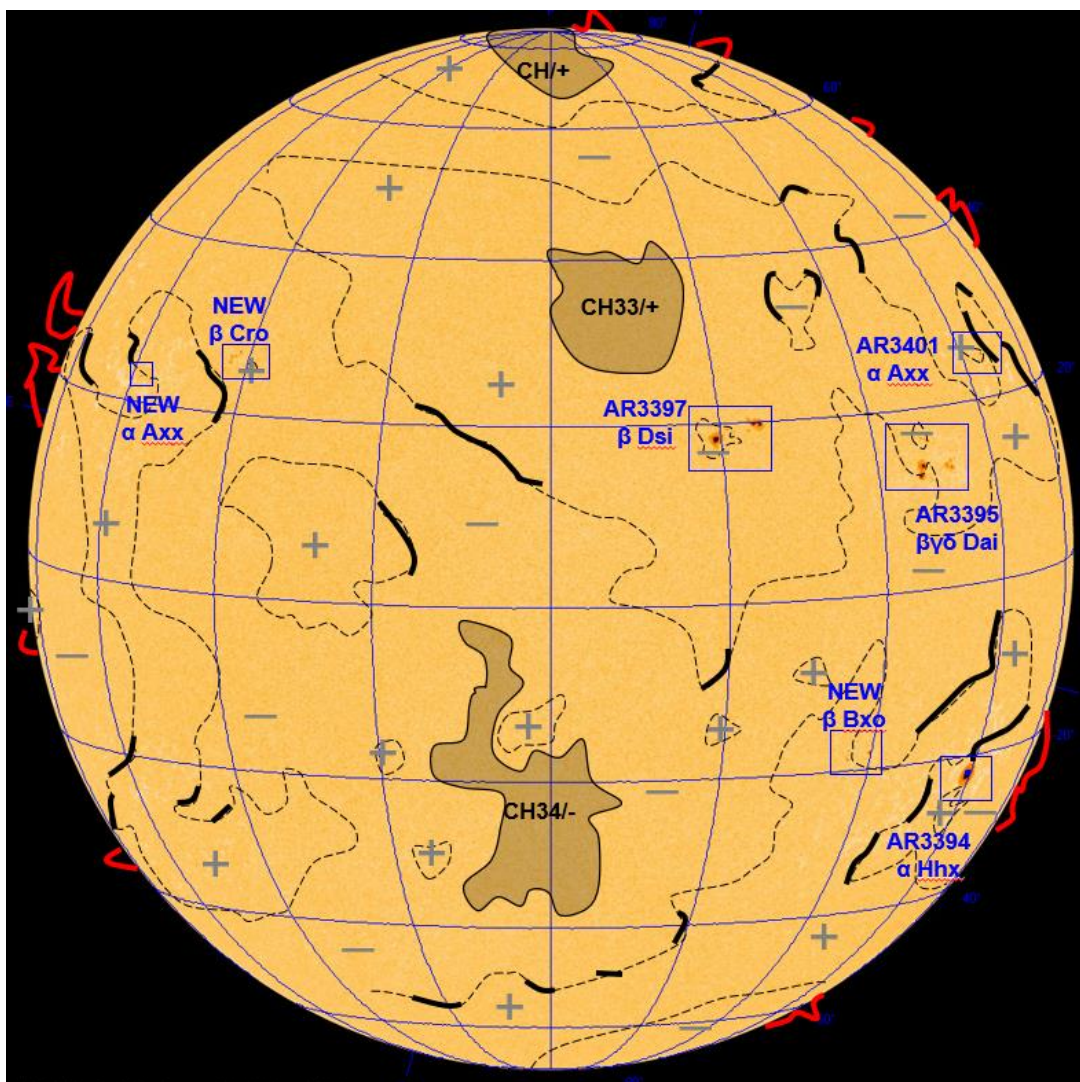
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geomagnetic activity initially, becoming Unsettled to Active (Kp 3-4) from Day 2, with an increasing Chance of G1/Minor Geomagnetic storm (Kp 5) intervals in association with coronal hole influences Days 2-3. The transition to a negative polarity coronal hole CH34/- is then a possibility, although not likely, late Day 4 (16 Aug) resulting in a very Slight Chance of a G1/Minor Geomagnetic storm interval.

Energetic Particles / Solar Radiation: No solar radiation storms are expected, with the high-energy proton flux expected to remain at resting Background levels and only a very slight chance of rising in response to any flares from more complex regions.

The high energy electron flux (greater than 2MeV at GOES16) is expected to show a similar diurnal oscillation in the near-term, before being attenuated further at GEO due to coronal hole related geomagnetic activity. There is a Chance of 24-hour integrated fluence rising to Active on Day 4 (16 Aug) as geomagnetic activity eases but this is only moderate confidence due to the possible onset and influence of a second coronal hole towards the end of the period.

Figure 1. Solar Analysis Valid 13/0800 UTC.



Key: Filament —, Prominence —, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs have been observed on available coronagraph imagery, and as such, no CMEs feature in the forecast period.

From late Day 2 (14 Aug) or early Day 3 (15 Aug) Earth is expected to connect to a HSS from CH33/+, which currently lies just west of the solar meridian in the northern hemisphere. This appears to have been present as a small and weakly defined feature on the previous rotation, and is now significantly larger and more defined; it has also retrogressed. The latest run of MOSWOC Enlil has this feature arriving as a marked CIR towards the end of the current UTC day (13 Aug), before segueing into a peak wind speed of around 500km/s by Day 3. Given the position of the coronal hole on the disc, a more likely arrival of a CIR is Day 2 resulting in Unsettled to Active activity (Kp 3-4), and a Chance of G1/Minor Geomagnetic storm intervals Days 2-3.

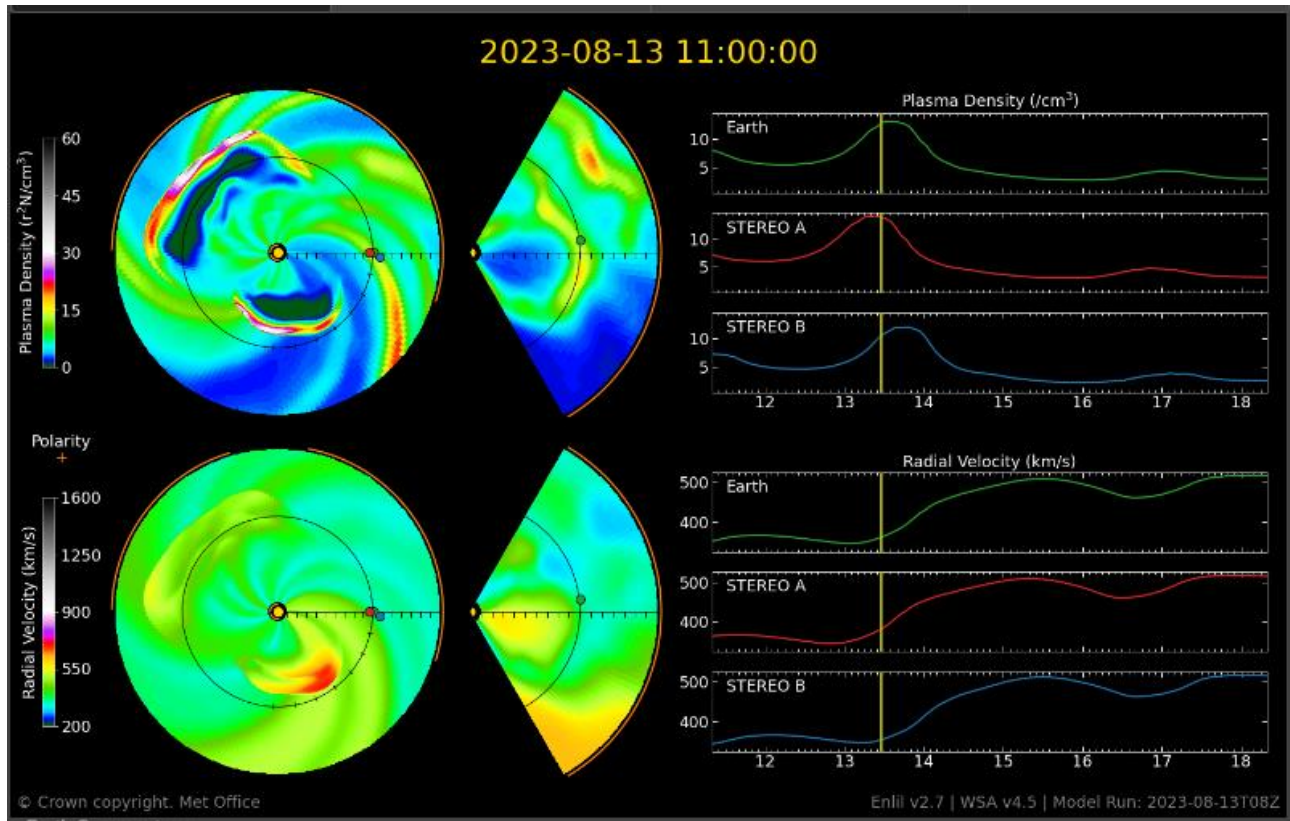
A brief lull in activity and decline in wind strengths is then anticipated towards the end of the period, as a second high speed stream from CH 34/-, is not expected to arrive within the scope of this forecast. This coronal hole, a visibly less defined region on the equator, was also present on the last rotation in a similar position. Should connection to this feature occur earlier than forecast, there is a slight chance of a G1/Minor Geomagnetic storm interval late on Day 4 (16 Aug).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	5	40	40	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

No CME's currently expected.

Figure 2: MOSWOC Enlil showing wind increases associated with CIR and HSS. Currently considered to be giving a reasonable steer.



Radio Blackouts - X-Ray Flares:

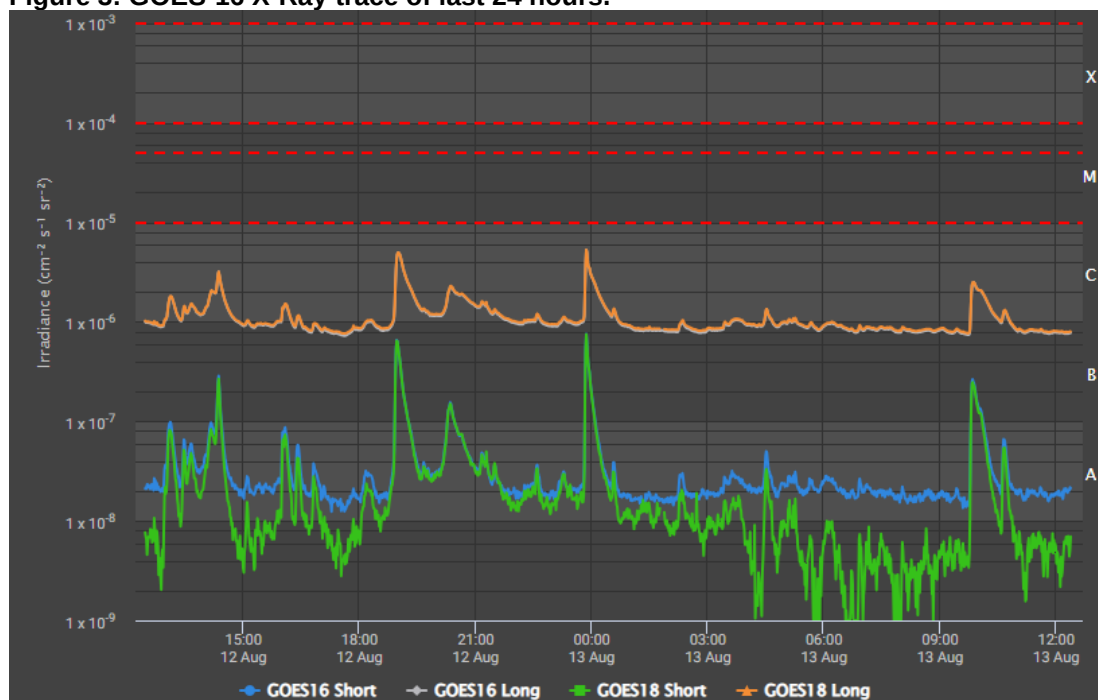
The probabilities of significant M- or X- Class flares suggested by the Zurich class of those regions on the visible disc, appear to not be reflected in the flare activity observed over the past 24 hours or so. AR3395 (Dai/Beta-Gamma-Delta) in particular has only produced C-Class flares despite its configuration classification. This sunspot region is showing signs of simplification including overall areal and delta spot decay. One other region in the northwest contributes towards the ongoing Chance of M-class X-ray flares, AR3397 (Dsi/Beta), which has shown recent development of its interior spots. The only other region of significance, is a quickly developing and maturing unnumbered region in the northeast of the disc. This region is expected to become increasingly geoeffective as it rotates across the disc.

On balance, regions AR3395 and AR3397 are due to rotate across the western limb by the very end of the four-day period, leading to a slight reduction around this time in the M-class risk. Any mitigation from the eastern limb far side is as yet unascertained, however soundings do suggest some northern hemisphere groups may emerge across the limb on Day 5 (15 Aug).

As such, activity is expected to remain Low, with a Chance of increasing to Active, most likely Days 2-3.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	40	40	30
Very Active	R3 to R5 X Class	No	5	5	5	1

Figure 3: GOES-16 X-Ray trace of last 24 hours.



Solar Radiation Storms - (High Energy Protons):

The flux of high energy (greater than 10 MeV) is well below the S1/Minor Storm level having returned to Background levels on 11 Aug.

There remains a very Slight Chance of further enhancements - mainly due to any notable flares from AR3395 in the northwest, although this spot group has no history of such.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux continues to exhibit a slightly attenuated diurnal oscillation, with flux levels expected to remain largely at Background levels Days 1-2 (13-14 Aug), with brief peaks close to or just above the High threshold. The next major influence or change, is the arrival of a CIR and HSS from CH33 most likely later Day 2 or Day 3 (14-15 Aug). After initial compression from the increased geomagnetic activity, there is a Chance of 24-hour integrated fluence rising to become Active at GEO. A second coronal hole high speed stream may again compress the Van Allen belt towards the end of Day 4 (16 Aug), but this is more likely beyond the forecast period.

MOSWOC REFM has hints of a rise in its forecast trend, as well as displaying a step-wise upward change from persistence Days 2-4, however given the detail of CH33 has changed, the onset and magnitude of this signalled increase is low confidence. REFM's 72-hour range does not yet have the scope to provide any information surrounding any second fast wind enhancement.

GEO Electron Environment	Level (cm ⁻² sr ⁻¹ day ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1x10 ⁸	No	1	10	10	40
Very Active	≥ 2 MeV ≥ 1x10 ⁹	No	1	1	1	1



Figure 4: GOES-16 Elecgttron trace of past 3 days

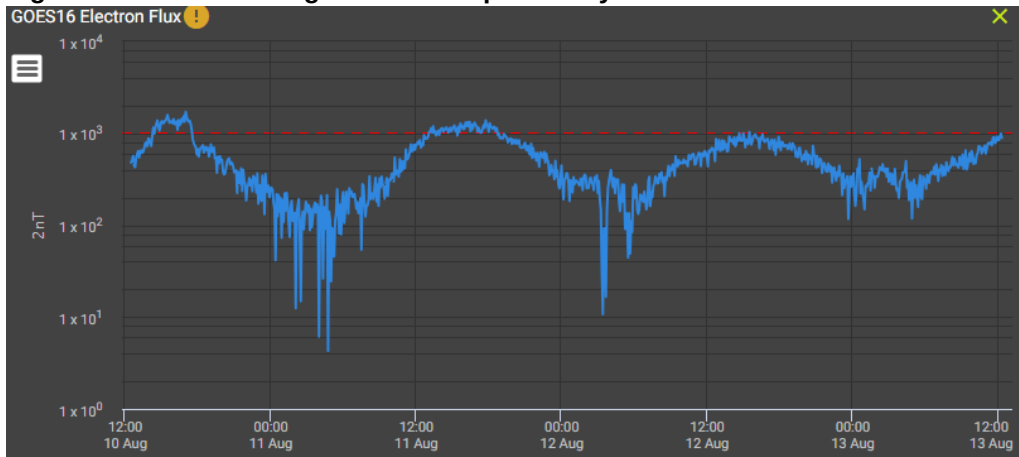


Figure 5: MOSWOC REFM. Forecast (white) is perhaps out of phase and may not capture the full expected intensity of the upcoming fast wind's enhancement.

